FILE COPY FOREST INSECT LABORATORY, UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA.

#5333
#60.6

UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Project | Date | Author

TITLE

SOME PHYSIOLOGICAL FACTORS ASSOCIATED WITH DECADENCE IN PONDEROSA PINE

JAM
MLL
~~KAG~~
JEP
GRS
HLM
ASW
JWB
~~CSE~~
RCH
JSY
STC
PCJ
ESS

By
R. C. Hall
Berkeley, California
May 16, 1941

U.S. GOVERNMENT PRINTING OFFICE 8—9742

SUBJECT—

INDEX No.—

Forest Insect Laboratory
Berkeley, California
May 16, 1941

SOME PHYSIOLOGICAL FACTORS ASSOCIATED WITH DECADENCE IN PONDEROSA PINE

APPROVED BY:

J. M. MILLER
Senior Entomologist, In Charge

SUBMITTED BY:

RALPH C. HALL
Associate Entomologist

SOME PHYSIOLOGICAL FACTORS ASSOCIATED WITH DECADENCE IN PONDEROSA PINE

During the latter part of the 1940 field season a study was conducted in the Hat Creek area on a few case history trees in an attempt to determine what some of the physiological factors were which were associated with tree decadence in ponderosa pines. A series of eight trees was selected for the preliminary study. Five had been recently infested by insects, one was in an advanced stage of decadence and two were vigorous trees. The analysis consisted of measurement of needle length, number of years of needle retention with the number of needles per fascicle each year, twig growth for the past twenty year period, and diameter increment in the bole at different levels. With the exception of diameter increment these data have been summarized and in view of some of the proposed work for the 1941 season it seems desirable to present this preliminary report. We are dealing with a very meagre sample in this study and for that reason definite conclusions are not warranted. However, they seem to point to certain angles of this study which should be given further more careful attention in the program for 1941.

Twig Growth

Because of the persistence of bud scales in ponderosa pine it is possible to determine annual growth of twigs going back 25 or more years. For the study it was decided to determine the annual growth of twigs back 20 years. One twig was selected at random from the east and west sides of the crown at three levels, the top, mid-section, and lower, making a total of 6 twigs from each tree. Data from the five infested trees were combined as were the data from the two vigorous trees. As only one decadent uninfested tree was analyzed, this was kept separate. This decadent tree was the one at Warners Bridge which was cut when Craighead visited the area and from which he collected several wood samples for growth analysis. A graphical comparison of these three classes of trees is made in Figure I. From this it may be noted that there was little difference in twig growth during the 12-year period of 1921 to 1932. However, from 1933 to 1940 inclusive there was a marked difference in twig growth. Note that this change in growth response started in 1933 following three years of unfavorable growth, 1930-31-32, and that the trees which were later attacked all failed to stage a substantial recovery. It is interesting to note that the decadent living tree followed essentially the same pattern as did the five decadent trees which were infested. Another interesting point which seems to be apparent from these meagre data is that these trees have been exhibiting signs of decadence for a period of eight years.

Figure I

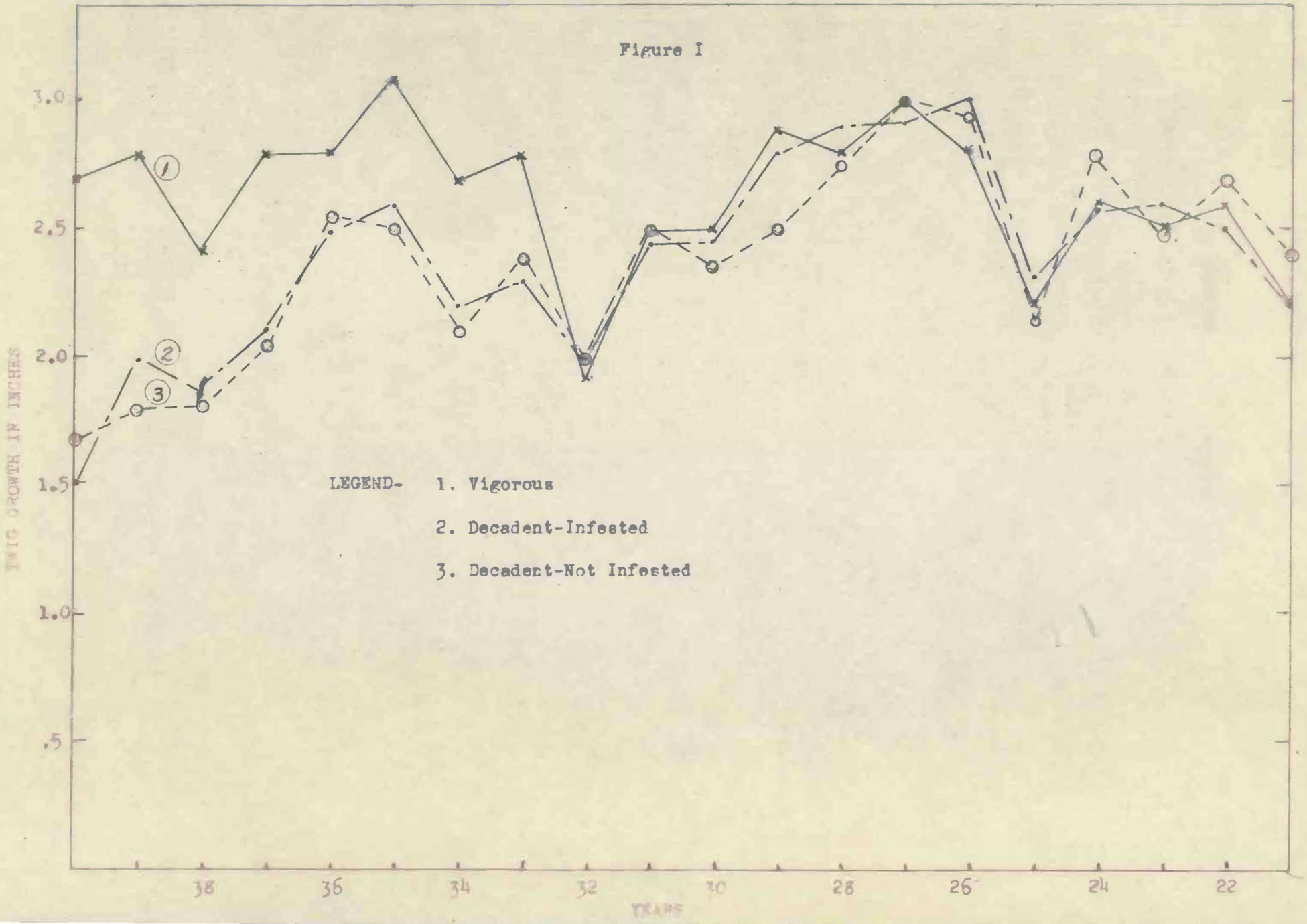
3.0
2.5
2.0
1.5
1.0
.5
TWIG GROWTH IN INCHES
1
2
3
LEGEND- 1. Vigorous
2. Decadent-Infested
3. Decadent-Not Infested
38
36
34
32
30
28
26
24
22
YEARS

Table I presents these data broken down into two periods from 1921 to 1932 inclusive and 1933 to 1940 inclusive.

Table I

Average Annual Twig Growth in Inches for Three Types of Ponderosa Pine Tree.

Period	Type of Tree (1) Vigorous	(2) Decadent Infested	(3) Decadent Not Infested	Comparison	Significance
1921-1932	2.54	2.53	2.55	1 with 2	N.S.
				1 with 3	N.S.
1933-1940	2.76	2.14	2.11	1 with 2	V.H.S.
				1 with 3	V.H.S.

Needle Length

For this part of the study approximately 500 needles were measured for each tree. These were selected at random for each year of retention, from the twigs which were selected for growth measurement.

There proved to be a highly significant difference in needle length for each year of retention between the figorous and decadent trees. A comparison of these data is presented graphically in Figure 2I.

The average length of needles on the vigorous trees was 10.0 inches compared to 7.1 on the decadent infested trees and 5.8 on the one decadent non-infested tree. The difference between the vigorous trees and both classes of decadent trees was highly significant, Table II.

Figure II

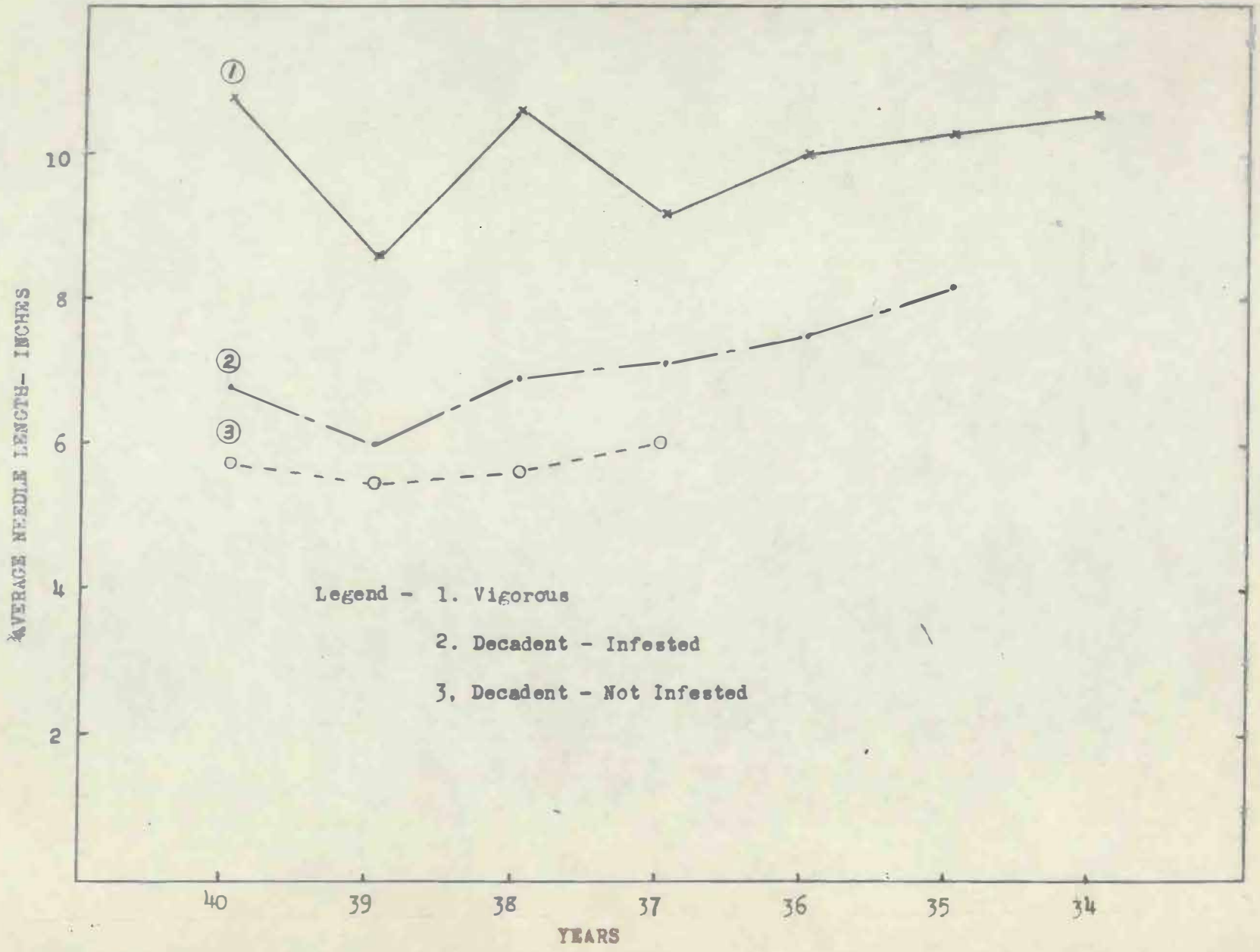
AVERAGE NEEDLE LENGTH- INCHES
10
8
6
4
2
40
39
38
37
36
35
34
YEARS
1
2
3
Legend - 1. Vigorous
2. Decadent - Infested
3. Decadent - Not Infested

Table II

Needle Length in Inches by Years for Three Types of Ponderosa Pine Trees

Year	Type of Tree (1) Vigorous	(2) Decadent Infested	(3) Decadent Not Infested	Comparison	Significance
1940	10.9	6.8	5.8		
1939	8.6	6.0	5.5		
1938	10.6	6.9	5.7		
1937	9.3	7.1	6.1		
1936	10.0	7.5			
1935	10.3	8.2			
Aver.	10.0	7.1	5.8	1 with 2	V.H.S.
				1 with 3	V.H.S.
				2 with 3	S.

Needle Retention and Complement

The number of years of needle retention and the average number ~~per~~ fascicle was determined for each tree studied.

There proved to be a highly significant difference in the number of needles ~~per~~ fascicle between vigorous trees and those showing marked signs of decadence. Table III. The average number of needles ~~per~~ fascicle proved to be 32 in the vigorous trees, 16 in the decadent infested trees, and 18 in the decadent non-infested tree. A comparison of these data by years is presented graphically in Figure III.

Figure III

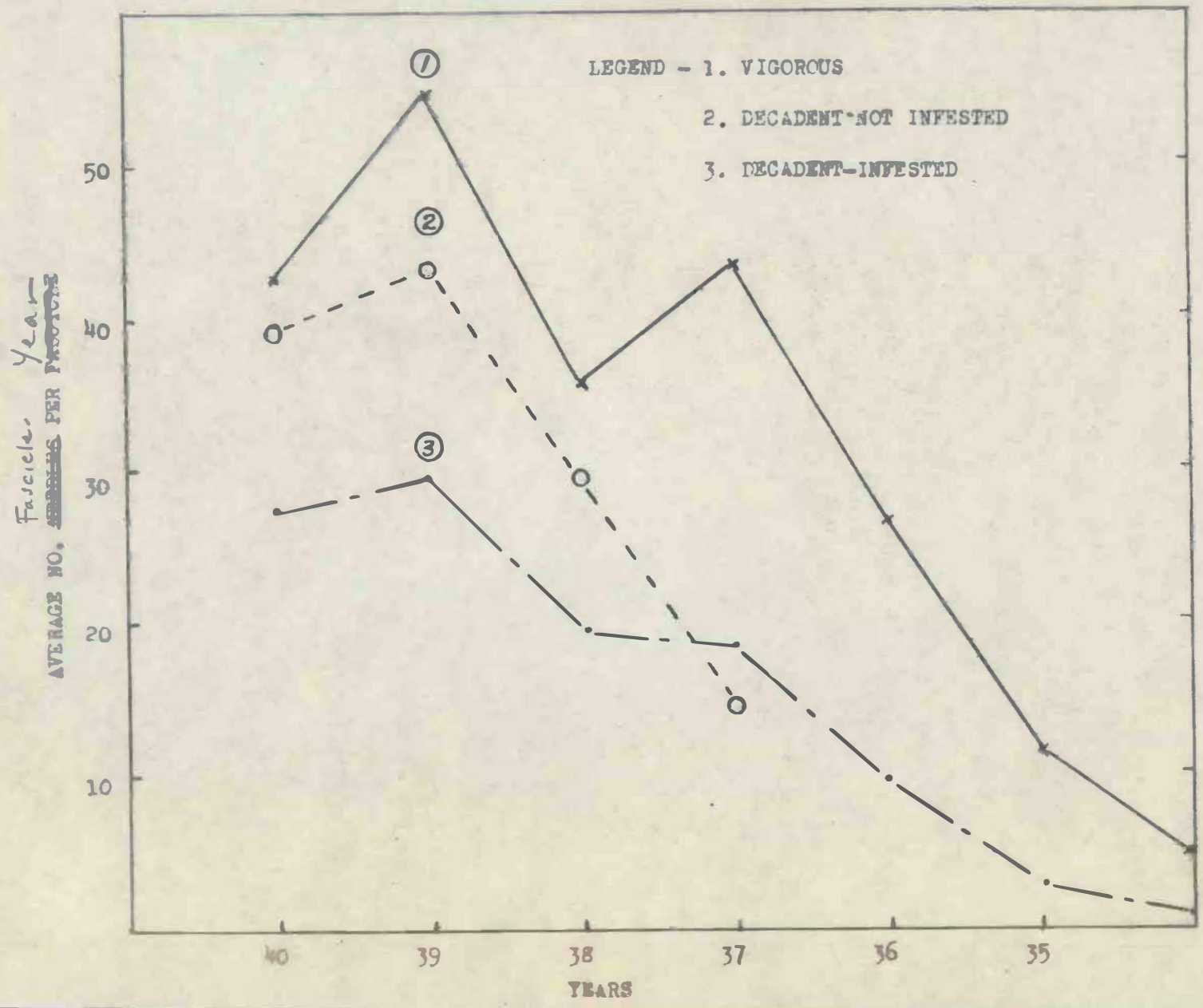
LEGEND - 1. VIGOROUS
2. DECADENT-NOT INFESTED
3. DECADENT-INFESTED
Fascicles Year
AVERAGE NO. SPRINGS PER PLOTTING
50
40
30
20
10
40
39
38
37
36
35
YEARS

Table III

Average Number of Needles per Fascicle by Years in Three Types of Ponderosa Pine

Year	TYPE OF TREE (1) Vigorous	(2) Decadent Infested	(3) Decadent Not Infested	Comparison	Significance
1940	43	28	40		
1939	55	30	42		
1938	36	20	30		
1937	44	19	13		
1936	27	10	0		
1935	12	3	0		
1934	5	1	0		
Total	222	111	125		
Aver.	32	16	18	1 with 2	V.H.S.
				1 with 3	V.H.S.
				2 with 3	N.S.

Summary

The above data appear to show that there are certain measurable factors in the crown of a tree which are indicative of marked decadence. These include greatly reduced twig increment for a period of about eight years, shortened needles, and fewer needles per fascicles, Table IV. It would appear from this that a vigorous tree in this area has made an average twig growth for the past eight years of 2.8 inches with an average needle length of 10 inches and 32 needles per fascicles, compared to a decadent tree with an average twig growth of 2.1 inches, an average needle length of 7.1 inches and 16 needles per fascicles. These preliminary data demonstrate the need for a further, more comprehensive study of this problem of factors associated with decadence together with an analysis of factors causing these decadent conditions. These are all to be considered in the program of study at Hat Creek for the 1941 season.

Table IV

A Comparison of Measurable Crown Characters in Three Types of Ponderosa Pine Trees

Character	Type of Tree (1) Vigorous	(2) Decadent Infested	(3) Decadent Not Infested	Comparison	Significance
Twig growth, 1921-1932, inches.	25.4	25.3	25.5	1 with 2	N.S.
				1 with 3	N.S.
Aver. Twig growth, 1932-40, inches.	2.8	2.1	2.1	1 with 2	V.H.S.
				1 with 3	V.H.S.
Aver. needle length, inches.	10.0	7.1	5.8	1 with 2	V.H.S.
				1 with 3	V.H.S.
				2 with 3	S.
Aver. No. needles ~~per~~ fascicles	32	16	18	1 with 2	V.H.S.
				1 with 3	V.H.S.

Copies sent to:

Craighead

Keen

Evenden